Uneven development patterns in global value chains

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An empirical inquiry based on a conceptualization of GVCs as a specific form of the division of labor

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ABSTRACT

This paper has three interconnected aims: proposing a novel and rigorous definition of a global value chain (GVC) that more easily permits the delineation of its frontiers; creating new indicators of GVC participation and value capture that can overcome the limitations of the existing ones; and offering empirical evidence demonstrating that participation in global value chains is part of an uneven development process that produces a variety of distinct integration patterns that differ with respect to economic and social outcomes.

The paper is structured as follows. Section 1 offers a definition of GVCs that conceives the latter as a specific form of the division of labor and therefore facilitates the delineation of the frontiers of a GVC. Building on this definition, Section 2 proposes new indicators to measure GVC participation and value capture. Section 3 provides empirical evidence to argue that, contrary to what mainstream economics and international organizations state, larger participation in GVCs does not necessarily lead to higher levels of value capture. Section 4 offers some theoretical justifications to interpret these findings and adds other measures such as the level of productive investment and dimensions of social outcomes in order to better understand differentiated development patterns in GVCs. Sections 5, 6 and 7 empirically show the heterogeneity of development patterns in GVCs for 51 countries between 1995 and 2008. Using country-level data on GVC participation, value capture, investment rates and social indicators (Gini coefficient, labor's share of income, median income and employment rate), we perform a principal component analysis and a cluster analysis. We find three distinct development patterns in GVCs: reproduction of the core, immiserizing growth, and a social upgrading mirage. We conclude by underlying the apparent complementarity between these development patterns and by identifying some limitations of the paper that open the way to further research.

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RÉSUMÉ

Cet article a trois objectif interconnectés : proposer une définition originale et rigoureuse d'une chaîne globale de valeur (CGV) qui permette de délimiter ses frontières plus facilement ; créer de nouveaux indicateurs de participation aux CGV et de capture de valeur qui puissent surmonter les limites de ceux qui existent actuellement ; et offrir des preuves empiriques qui montrent que la participation aux chaînes globales de valeur est un processus qui produit une variété de formes d'intégration qui différent en termes de résultats économiques et sociaux.

L'article est organisé comme suit. La Section I offre une définition des CGV qui les conçoit comme une forme spécifique de la division du travail et facilite ainsi la démarcation des frontières d'une CGV. En s'appuyant sur cette définition, la Section II propose de nouveaux indicateurs pour mesurer la participation aux CGV et la capture de valeur. La Section 3 apporte des preuves empiriques pour argumenter que, contrairement à ce que l'économie orthodoxe et les organisations internationales soutiennent, une plus grande participation aux CGV ne conduit pas nécessairement à des niveaux de capture de valeur plus élevés. La Section 4 offre quelques justifications théoriques pour interpréter ces résultats et ajoute d'autres mesures telles que le niveau d'investissement productif et des indicateurs sociaux dans l'objectif de mieux comprendre les modèles de développement différentiés dans les CGV. Les Sections 5, 6 et 7 montrent empiriquement l'hétérogénéité des modèles de développement dans les CGV pour 51 pays entre 1995 et 2008. En utilisant des données de niveau national sur la participation aux CGV, la capture de valeur, le taux d'investissement et des indicateurs sociaux (coefficient de Gini, part des salaires dans le revenu, revenu médian et taux d'activité) nous réalisons une analyse en composantes principales et une analyse de cluster. Nous trouvons trois modèles de développement différentiés dans les CGV : reproduction du noyau, croissance appauvrissante et mirage de progrès social. Nous concluons en soulignant l'apparente complémentarité entre ces modèles de développement et en identifiant quelques limites de l'article qui ouvrent la voie à de la recherche future.

Introduction

Two different groups are currently using the Global Value Chains (GVC) framework. On the one hand, policy institutions provide the standard measurements of GVC involvement and realize cross-country analysis to formulate policy recommendations. On the other hand, scholars from various disciplines elaborate on GVCs and GVC-related concepts (Antràs, 2014; Milberg and Winkler, 2013; Ponte and Sturgeon, 2014; Yeung and Coe, 2015a). Unfortunately, the former group (policy institutions) is often conducting its measurements with at best a rough and imprecise link to the recent achievements of academic theorists. As stated by Gereffi, "much of the literature that uses the GVC moniker misses the point and doesn't apply the framework consistently" (Gereffi, 2014, p. 27). Meanwhile most of the academic scholars have not yet managed to address the theoretical challenges associated with new empirical discussions and policy debates. Since critical views on GVCs are usually made by theorists, there is a need to forge concepts that could be mobilized in order to provide empirical support to critical approaches to GVCs.

This contribution proposes to overcome this disjuncture between theory, on the one side, and macro, multi-country measurements, on the other. It offers some original findings concerning the relation between countries' GVC participation and economic and social upgrading.

The second section addresses the limitations of GVC theorization and measurement and proposes to conceptualize GVCs as a specific form of the division of labor, distinct from both a market-led social division of labor and the internal organization of labor inside of firms. One achievement of this definition is to allow for a precise delimitation of the frontiers of GVCs and, accordingly, to propose more appropriate measures of GVC participation and value capture than currently employed (section 3), along with presenting some stylized facts based on these measures, which do not support the narrative of international institutions concerning GVC participation and economic upgrading (section 4). We then draw on various strands of literature to delineate 3 country development patterns depending on the modalities and intensity of GVC participation and independently of the products traded (section 5). Relying on trade data and standard indicators of economic and social upgrading (investment rates, value capture, median income, labor share, Gini index, employment rate) from the OECD, the IMF, the Luxembourg Income Study, UNCTADstat, the World Bank and supplemental sources, we realize a principal component analysis for 51 countries between 1995 and 2008 (section 6). Our results discussed in section 7 challenge the dominant narrative of a clear positive relation between GVC participation and social and economic upgrading, and instead describe a much more nuanced and contrasted relationship that reflects the unevenness of development patterns along GVCs.

1. Conceptualizing GVCs, again

1.1. The policy-theory mismatch in the GVCs literature

Over the past few years, research inspired by the value chains literature attained a new dimension. While it used to be limited to an accumulation of case studies, with some biases toward success stories (Bair, 2009), more recently a growing strand of research mobilized this framework to build cross-country analyses at the macro or industry level (De Backer and Miroudot, 2014, pp. 11–16; Durand and Miroudot, 2015; Gangnes et al., 2015, p. 115; OECD, 2013, p. 12; UNCTAD, 2013, pp. 135–136). This represents a significant improvement in the way knowledge on GVCs could inform policies, as such international studies are better able to capture development patterns at the macro level as well as avoid potential fallacy of composition problems – referring to situations where each successful micro case renders the prospect of generalized success less possible – that have been found in non-GVC analyses of export-led growth strategies (Razmi and Blecker, 2008).

Unfortunately, standard measurement of GVC participation poorly reflects the conceptual elaboration of GVCs theorists (Antràs, 2014; Milberg and Winkler, 2013; Ponte and Sturgeon, 2014; Yeung and Coe, 2015a). For example, one of the most comprehensive reviews of the approaches of seven United Nations agencies to value chain development concludes that there is considerable "fuzziness" about how the concept is adopted: "…[value chain]-related activities sometimes seem to be rather the outcome of 're-labelling' former private sector development interventions. In other cases, activities that could clearly be subsumed under the value chain approach are not labeled accordingly….These observed shortcomings in knowledge management, transparency and the lack of defined unique selling positions make inter-agency cooperation in [value chain] promotion difficult" (Stamm and von Drachenfels, 2011, p. 30). As stated by one of the most prominent figures in the GVC research domain, "much of the literature that uses the GVC moniker misses the point and doesn't apply the framework consistently." (Gereffi, 2014, p. 27).

To be fair, this difficulty in policy-related research reflects, in part at least, a lack of theoretical articulation of the GVCs framework, as noticed by numerous authors in the field. Most existing conceptual approaches are not *explanatory* and *causal* enough to provide a coherent theory (Yeung and Coe, 2015b). Global Commodity Chains (GCCs), Global Value Chains (GVCs), Global Production Networks (GPNs), Trade in Tasks, etc. – the instability of the denomination is symptomatic of a lack of clarity[1]. Even more confusing, some terminological opposition is misleading. For example, the distinctions between the GVC and GPN theoretical frameworks are overdrawn and their implications for empirical work overstated. The use of one concept or the other does not even reflect

[1] We cannot here revise the specific advantages and shortcomings related to these various denominations. Let us just state that we chose to retain the term of Global Value Chains because it is the most widely used, the less theoretically charged and, more positively, because of the emphasis put on value, which points to both productive dynamics and distributional stakes. On October 29 2015, a Google search obtained 382,000 results for « global value chains », 112,000 for « global production networks », 42,700 for « global commodity chains » and 22,300 for « trade in tasks ».

real divergences concerning the conceptualization of chain governance, specifically the attention that different authors pay to inter-organizational dynamics along the chain versus the role of structural power relations shaped by institutional settings and deliberate actions of non-firm actors such as NGOs, unions and states (Bair and Palpacuer, 2015).

We contend that at the root of this conceptual disarray lies a very basic problem of definition. What is a global value chain? GVCs are most of the time defined in the literature in a descriptive manner, for example as "*the full range of activities that firms and workers perform to bring a specific product from its conception to its end use and beyond*" (Gereffi and Fernandez-Stark, 2011). In addition to its lack of analytical content, such a definition raises immediately the problem of the frontiers of GVCs. If this concept refers to the international segmentation of value producing activities, it must also address the distinctiveness of the economic relations involved in GVCs vis-à-vis other economic relations, and thus the frontier of the chains.

Property rights theorists emphasize this aspect when they state that trade within global value chains is qualitatively distinct from trade in final goods because transactions involving intermediate inputs "*tend to be associated with longer time lags between the time the order is placed (and the contract is signed) and the time the goods or services are delivered (and the contract executed), and they also often entail significant relationship-specific investments and other sources of lock in on the part of both buyers and suppliers*" . The advantage of such a definition is that it tries to capture the economic specificity of economic relations within global value chains. However, it reduces its content to characteristics of production processes in terms of asset specificities and duration and solely considers the efficiency of transaction arrangements, ignoring the role of power relations and strategic behaviors in the enforcement and reproduction of these arrangements and the subsequent socio-economic outcomes[2]. In order to capture social and economic principles supporting relations along global value chains, one needs to conceptualize them as a *"form of industrial organization"* (Milberg and Winckler, 2013, p. 19) or, more precisely, a form of the division of labor characterized by distinctive modalities of coordination and power relations.

1.2. Global value chains as a form of the division of labor

Most of the theoretical discussion concerning global value chains has focused on industrial governance issues and specifically on « (1) how exchanges between actors at different links in a chain are coordinated; (2) who among the participants in the chain is able to define and/or control the process of coordination; and (3) what the consequences are of these coordinating activities for chain participants in terms of the distribution of risk and reward » (for the main references see Bair and Palpacuer, 2015 : S3). These are crucial issues to understand contemporary development patterns. However, how to address them depends on the very delimitation of value chains.

[2] For a general discussion about the achievements and the limitations of transaction cost economics see the book coordinated by Christos Pitelis (Pitelis, 1994).

Our definition of a global value chain is rooted in the concept of the network firm (Chassagnon, 2014; Powell, 2003). The latter differs from other forms of industrial organization in that it describes a vertical network of firms with complementary assets and skills that coordinate through various cooperation mechanisms, power exploitation being one of the main ones. However, we push the argument further, by stating that asymmetric economic relations are related to uneven control over the production process itself, below the legal frontier of the firm (within dispersed affiliates of TNCs) and beyond the legal frontier of the firm (with subcontracting and retailing networks).

Consequently, we propose to consider global value chains as a specific form of the division of labor, distinct from two archetypical forms: the division of labor within a single establishment unitary firm typical of nineteenth century capitalism and the division of labor driven by horizontal market mechanisms (Table 1). However, rather than relying on the distinction between markets and hierarchies made by transaction costs theory (Coase, 1937; Williamson, 1983), we build on the Marxian distinction between the technical and social division of labor, i.e. the division of labor within a given manufacturing process versus the broader division of labor in society as a whole (Chavance, 2009; Marx, 1981). Both forms of the division of labor contribute to the refinement and development of production as famously stated by Smith in *The Wealth of the Nations* (Smith, 1776). However, Marx points out that these forms of the division of labor are not only different in their scale (the unitary firm versus society) but because they rely on fundamentally distinct social principles and thus encounter very different socio-economic problems: the product is a commodity in the social division of labor but not within the firm; the coordination results from a priori planning in the unitary firm while it is mediated by prices and validated only following the process of production within the social division of labor; ownership of the means of production is unified within the manufacturing process while dispersed in the case of the social division of labor; means of production and labor are allocated proportionally to the requirement of the planned production process in manufacturing and as a function of the hazardous competition process in the case of the social division of labor. Contemporary forms of capitalist organization move beyond this binary structure with formally independent firms being incorporated in production networks where capitalist functions related to the organization of the labor process and the appropriation of profit are unevenly distributed (Bettelheim, 1970, p. 123).

Global Value Chains are a form of the division of labor that takes place within such production networks – whether or not directly internal to a transnational corporation (TNC) - in which geographically dispersed productive entities contribute to the making of a commodity[3]. Within value chains, "incomplete commodities" are functionally integrated in order to make complete commodities, which will be sold and used beyond the chain. The criterion to consider a product as an incomplete commodity is that its potential value realization outside the chain would be lower than within it. To put it differently, because of their complementarity, the diverse products circulating within a

[3] Elements of this analysis were previously traced in Aglietta's analysis of sub-contracting networks (Aglietta, 1979); on the related issues of possession and economic property relations see (Bettelheim, 1976; Lipietz, 1989; Poulantzas, 1976).

value chain have a higher value when they are combined than if they were sold separately. This complementarity manifests at a deeper level the fact that a variegated set of command mechanisms allows lead firm(s)[4] to shape the labor process (technology, labor standards, etc.) within the network and that internal or transfer prices along the chain gives lead firm(s) the ability to capture part of the profits generated in formally autonomous entities. The frontier of a given value chain is reached when price mechanisms become disconnected from the command over production parameters; the product then becomes a (full) commodity.

In sum, GVC-related trade organizes an institutional and economic production space where one (or a small number of) lead actor(s) exert(s) economic power to (partially) centralize profits and control(s) to some degree the labor process over geographically and often legally dispersed productive units. The allocation of labor and means of production within the chain results both from the hazardous process of vertical competition between unevenly powerful and relatively autonomous entities and from explicit strategic planning by the lead firm(s). The coordination is thus dominated by cybernetic just in time planning, incorporating prices, quantities and qualities data.
Of course, a crucial specificity of contemporary global value chains is that they are structured at the global or regional level. This trans-nationalization means that uneven factor endowments and institutional settings between countries are key drivers of value chains dynamics while they are in the meantime affected through a feedback loop by these same dynamics.

Table 1: Technical, social and value chain divisions of labor

Division of labor	TECHNICAL	SOCIAL	VALUE CHAIN
SCALE	Unitary firm	Society	Production network
PRODUCT	Not a commodity Intermediary use-value without exchange value	Commodity Use-value with exchange value	Incomplete commodity Intermediary use-value with a formal/coerced exchange value (intra-chain internal or transfer price)
MEDIATION	Command and control Top-down orders along the management hierarchy	Prices A priori horizontal between market participants	Mixed Asymmetric prices and command and control relationships between lead actor(s) and relatively autonomous peripheral actors
COORDINATION	A priori	A posteriori	Cybernetic just in time planning by lead firm(s)
OWNERSHIP OF THE MEANS OF PRODUCTION	Unified	Dispersed	Geographically and (often) legally dispersed

[4] By lead firm we consider the dominant firm in the network or the parent company in the case of intra-TNC transactions.

ALLOCATION OF LABOR AND MEANS OF PRODUCTION	Proportional	Hazardous, regulated by horizontal product competition	Hazardous, regulated by vertical factor competition

2. A critical reappraisal of GVC measurement

2.1. How to measure GVC participation?

The prevailing state of ambiguity concerning the conceptualization and definition of GVCs finds its mirror image in the eclecticism seen in approaches toward GVC measurement. We contend, however, that our understanding of GVCs as a specific form of the division of labor in contemporary capitalism allows us to posit a measure of GVC participation that is more precise than those currently used in the literature.

To take an example of some of the imprecision involved on the measurement side of the literature, a recent UNCTAD (2013: x) *World Investment Report* dedicated to global value chains estimates that "TNC-coordinated GVCs account for some 80 percent of global trade." Although this figure has subsequently entered the literature as an estimate of the extent of global GVC trade (Abdulsamad et al., 2015, p. 1; Elson, 2013, p. 49; Yeung and Coe, 2015a, p. 30), it is actually an estimate of the percentage of international exchanges that feature TNCs as either buyer or seller (UNCTAD 2013: 135-136). Yet the use of TNC presence is at best a poor proxy for GVC trade from our point of view, as it simultaneously casts the net too wide, insofar as TNCs must still purchase some full commodities, notably primary products, through market and price revelation processes symptomatic of a social division of labor; and too narrow, insofar as an international exchange between two domestic (non-TNCs) firms could be coordinated inside a GVC, particularly toward its lower nodes.

A more common standard of measurement in the literature – indeed one used in the very same UNCTAD report (2013: 170) for estimating GVC participation at the country instead of the global level – is that of vertical specialization (VS). Defined as the import content of exports, or the foreign value-added content of total exports, vertical specialization aims to gauge how dependent a country's export sector is on foreign inputs. Since (Hummels et al., 2001, pp. 81–82) suggested the inclusion of forward participation in vertical specialization (the export of goods that become inputs in another country's exports), which they label VS1, it has become the norm for VS and VS1 to be taken as the measure of a country's (backward and forward) participation in GVCs (De Backer and Miroudot, 2014, p. 10). Using such a measure, most countries count somewhere between 30 to 60% of their gross exports as GVC related trade, that is, either VS or VS1 (de Backer and Miroudot 2014: 11-12). For the world as a whole, the share of global trade that is GVC related peaks at around 52 percent in 2008 (Gangnes et al., 2015, p. 114).

Nonetheless, as with the TNC proxy measure offered by UNCTAD, the combination of VS and VS1 as a proxy for GVC trade leaves considerable room for further precision in light

of the conceptualization of the frontiers of GVC activity offered in this article. Figure 1 below decomposes a given country's total imports and exports in a way that highlights the differences between our conceptualization of GVC trade and the standard VS + VS1 measure.

Figure 1: What counts as GVC trade out of a country's total international trade

As can be seen from Figure 1, the full measure that we use for the rate of GVC participation is as follows:

Equation 1: GVC participation rate

$$\frac{(DVA\ in\ X) * (1 - ppX) + ipM * (1 - ppM)}{GDP}$$

Where "DVA in X" is domestic value added in gross exports, "ppX" is the share of primary products in total exports, "ipM" is gross imports of intermediate products and "ppM" the share of primary products in total imports

Two key differences are immediately noticeable between the approaches that allow for a more precise measurement of GVC participation. First of all, there is the distinction between primary and non-primary products. Overlooked by the standard measurement, this distinction results from our conceptualization of GVCs as a form of division of labor whose frontiers end where market coordination dominates, i.e. where negotiations

between sellers and buyers are limited to prices and payment conditions and where pricing is revealed more through market mechanisms than direct firm-to-firm negotiations. This is all largely the case for primary products due to their unique use-values, which by nature differ from secondary products in terms of being rigidly local in terms of where they need to be produced, notably homogenous in composition and therefore relatively impervious to product differentiation, and generally inflexible regarding the duration of their production and therefore the time required to bring new products to market. Largely for these reasons, Kalecki considered that primary products tended to be exempted from cost-determined pricing (Lavoie, 2015, pp. 125–126). In the case of GVCs, we should note that the specifically local conditions of their production render their geographical fragmentation generally impossible, while the unusually long and inflexible length of their production cycle renders their extra-market coordination problematic (Dicken, 2011, pp. 253–271), and their specific role as an asset class on financial markets further removes pricing from inter-firm negotiations in a potential GVC (Newman, 2009, pp. 550–556). Of course, this is not to say that no primary product may be organized, produced and sold in a GVC division of labor, but rather that their general existence as full commodities beyond the frontiers of GVC pressures will lead to more precise estimates of GVC participation if they are excluded. An additional benefit of excluding primary products in this manner is that it avoids misleading conclusions for commodity exporting countries with inflated GVC participation as well as value capture figures that would have been more of a result of the timing of the 2000s commodity boom (Powell, 2015) as it relates to the time period of our data than to dynamics in global value chains themselves.

The second noticeable difference that we have with the standard measurement is our inclusion of all imports and exports of non-primary products as GVC trade, with the exception of the direct import of a finished product for domestic use. While the literature prefers that a product has crossed at least two borders in order to classify it as part of a GVC (Hummels, Ishii and Yi 2001: 76), (Wang et al., 2016, p. 14) note that a broader definition of GVCs would include goods that have not necessarily crossed two borders. The narrow preferences of the two border rule in the standard measurement leads to the omission of much GVC trade, as it classifies all exports as non-GVC related for the penultimate country in a GVC (that is, the final exporter of either a finished good or an intermediate input that is absorbed in the host country without further international trade) because of the lack of certainty that such a good involved more than two countries. The same is true for the importer on the opposite side of the transaction. Yet in our conception of GVCs, what matters is not the number of countries that were involved in a GVC but the type of relations involved in the command over production. And unlike the case for primary products, which are exempted for special reasons explained above, all firm activity in exporting or importing secondary goods today, the vast majority of such sales involving trans-national corporations (UNCTAD 2013: 135-136), can be assumed to have been organized in GVC relations.

As can be seen, the only exception in our conceptualization of treating secondary goods trade as GVC trade is the case of an import of a finished good for direct consumption. This is because the statistical category in question (imports of finished goods) is not able to distinguish between imports of finished goods for direct use, and imports of finished secondary goods by a firm to be sold domestically. The latter could be assumed to be GVC related for the importing country to the extent that the retailer contributes to the

very definition of the product itself, but not the former. Therefore, the exclusion of this category undoubtedly misses much GVC related trade for a given country; for example, Walmart or Ikea's imports of finished products for retail trade. Nonetheless, this is a limitation that is shared with the standard measure. Given that this category is the only one where such ambiguity exists – in other types of imports and all types of exports it is clear that a commercial firm is doing the buying or selling – we decided to exclude it in order to under rather than over-estimate the extent of GVC participation.

One last difference between our measure and the standard in the literature that is not observable in figure 1 is that we have opted to obtain a ratio for GVC participation through dividing by GDP rather than following the usual practice of dividing by gross exports. This is because our purpose is not that of seeing how much of world trade has become GVC trade, but is rather in looking at the developmental effects of the GVC division of labor in a world where successfully linking into GVCs is standard policy advice and indeed has become "nearly synonymous with economic development itself" (Milberg and Winkler 2013: 238). From this point of view, the level of openness to GVCs is gauged relative to the economy itself rather than relative to whatever happened to be the pre-existing weight of exports in the economy. In other words, our indicator can be interpreted as a measure of the value involved in GVC trade relative to the value created in a country, i.e. relative to the size of a country's economy.

2.2. How to measure value capture?

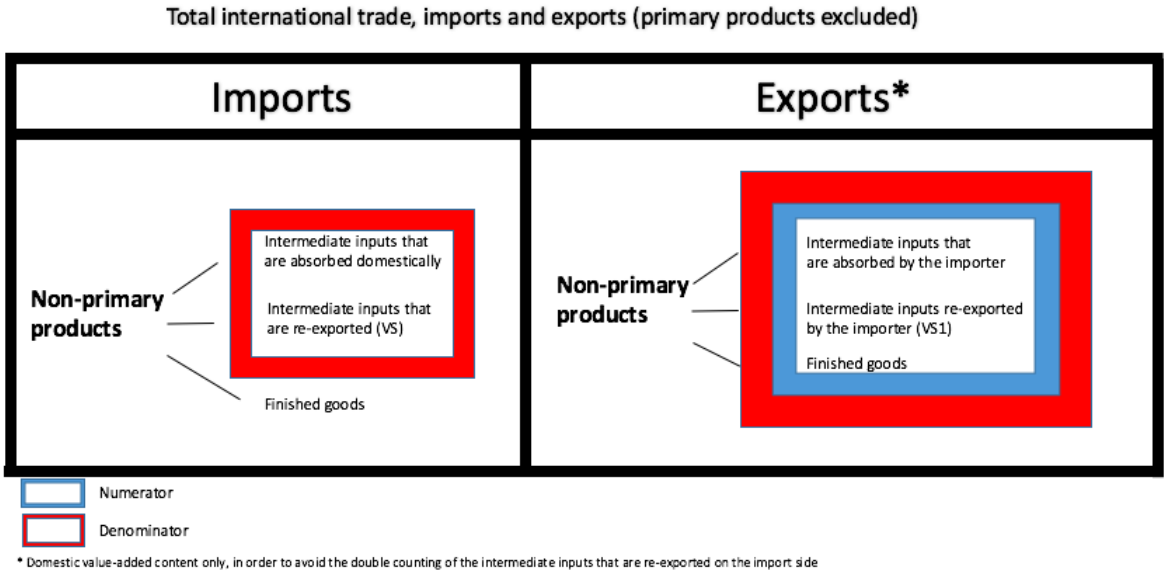
The current approaches to measuring country gain from GVC trade are even more varied than approaches to GVC participation. While our choice to use a value capture measure as a country gain indicator has been used in previous literature (Jiang and Milberg, 2012; Milberg and Winkler, 2013), others argue against its use. The case against the value capture indicator is that a reduced share of value captured domestically can occur along with upgrading in other senses, especially if there is a deepening of technological sophistication in activities performed (UNCTAD 2013: 172). A stronger rejection of both sophistication and value added understandings of upgrading comes from (Kowalski et al., 2015, pp. 7, 33), who argue that volume can be as important as value, or that "a smaller share of a larger pie" is better because "important benefits can be derived from specializing in less sophisticated assembly activities according to comparative advantages and performing them on a large scale." Some alternative measures employed range from sophistication of exports and per capita domestic value added in exports (Kowalski et al. 2015) to, more commonly, GDP per capita (OECD et al., 2014, p. 18; UNCTAD, 2013, pp. 150, 170).

Yet while it is true that there can be a "short-term trade off" in potentially entering an "upgrading path" through increased GVC participation that reduces the share of domestic value capture (UNCTAD 2013: 170-172), there are nonetheless major problems with discarding value capture in favor of alternative indicators unrelated to it. Exports can be sophisticated because foreign inputs are, but that does not mean the exporting country keeps the value it exports. There could be an upgrading mirage. Second, simply increasing per capita domestic value added in exports ("a bigger pie"), something every single country in our sample has unsurprisingly accomplished during an era where world trade has mostly outpaced GDP growth (Escaith and Miroudot,

2015), does not necessarily translate into industrial upgrading in the way it is normally considered in the literature. Indeed, whatever its benefits in terms of expanding economic activity, the growth of volume of sales at low-value added levels of a value chain is identified in the literature as a new form of "thin industrialization" or a "low-level equilibrium trap" that is associated precisely with an inability to upgrade (Milberg et al., 2014, p. 171). Third, growth in GDP per capita can be attributed to many factors. The papers that use this indicator do not control for these other factors. Value capture rates are a more direct economic outcome of GVC participation, and therefore a more precise measure.

Our proposed measure of value capture in GVC trade is the ratio of domestic value-added in GVC exports to total GVC related trade (Figure 2). Along with maintaining our exclusion of primary product trade from our conception of GVC activity, the other distinguishing characteristic of our value capture measure is that we consider the ratio of domestic value-added in exports not only to that of foreign value-added in exports (i.e. re-exported intermediate inputs, the standard measure (UNCTAD 2013: 150) but also to that of imported intermediate inputs absorbed domestically.

Figure 2: Measuring a country's gain from GVC trade – rate of value capture



The formula that emerges to calculate the value capture rate, therefore, is as follows:

Equation 2: Value capture rate

$$\frac{(DVA\ in\ X) * (1 - ppX)}{(DVA\ in\ X) * (1 - ppX) + ipM * (1 - ppM)}$$

Where "DVA in X" is domestic value added in gross exports, "ppX" is the share of primary products in total exports, "ipM" is gross imports of intermediate products and "ppM" the share of primary products in total imports

As the reader can notice, the numerator of Equation 2 corresponds to the total value captured by a country when exporting non-commodity products and the denominator to the total value of GVC-related trade as defined above (the numerator of Equation 1).

The reason for including domestically absorbed intermediate imports in our GVC gain ratio stems directly from our above conceptualization that sees all secondary goods trade (excluding the import of finished goods) as GVC trade. Thus, this type of GVC import represents a real cost that could offset some of a country's gains in terms of capturing value through GVC exports. In the case of some countries where the cost of such imports is particularly high due to an underdeveloped domestic input sector, omitting domestically absorbed intermediate imports from the denominator of the value capture measure would therefore give an unrealistically high value capture rate. Including such real costs of GVC participation as well as the gains from value capture in exports provides a more precise measure of the real gains from participation.

3. Stylized facts on the link between GVC participation and value capture

Having developed what we believe are more accurate indicators of GVC participation and GVC-related direct economic benefits (our version of the value capture rate indicator) than the ones currently used in the GVC empirical literature, we will revisit the link between GVC participation and value capture. We will show that, contrary to what the prevailing view describes (Kowalski et al., 2015; OECD et al., 2014, 2013; UNCTAD, 2013), there is not a straightforward positive link between GVC participation and direct economic benefits.

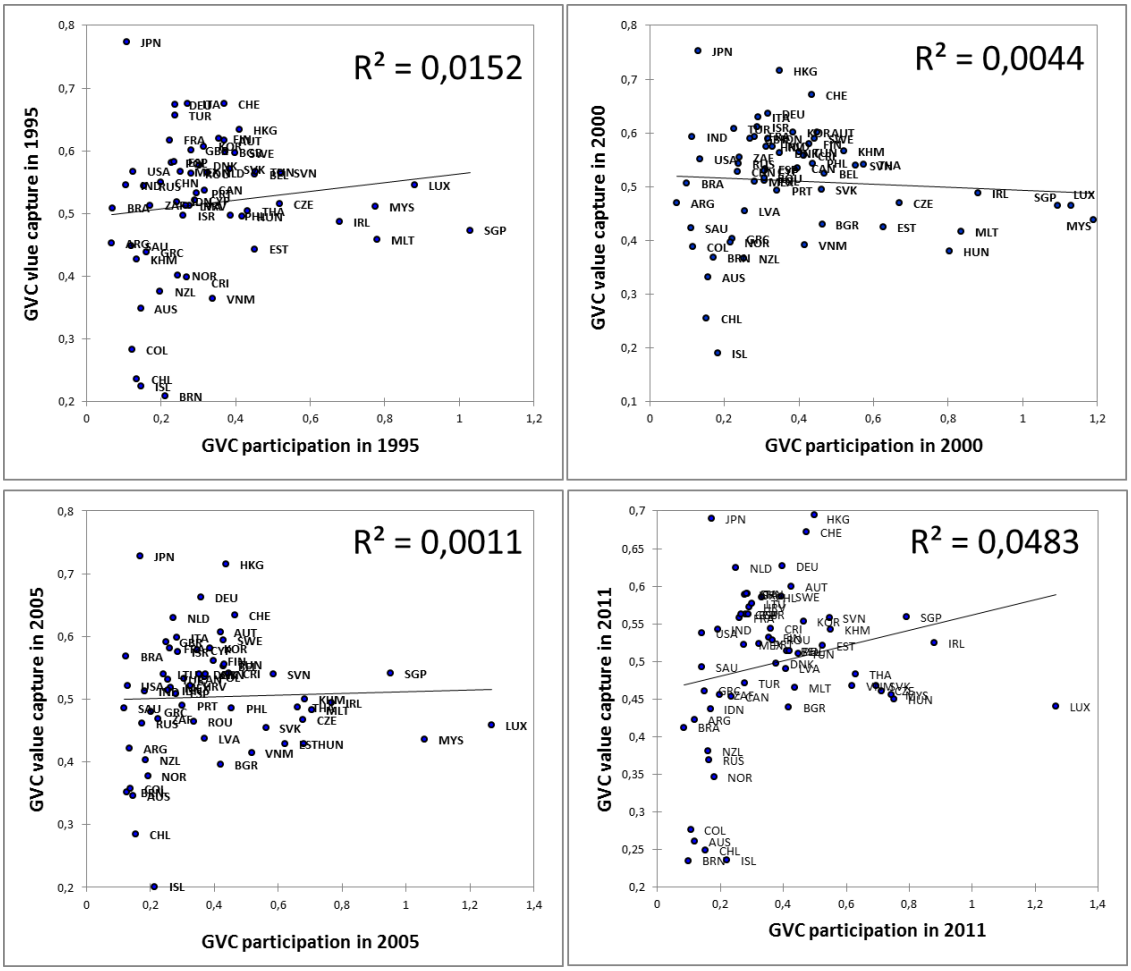
The link between GVC participation and value capture can be analyzed in two non-contradictory ways: statically and dynamically. The first approach comes down to answering, for a specific period the question "are countries that participate the most in GVCs the ones that capture more value?". The second approach (the dynamic approach) asks a similar question that introduces time in the analysis: "are countries that have increased their participation in GVCs during a certain period (for example, between 1995 and 2008) the most also the ones whose value capture has increased the most?". In this section we will analyze the above-mentioned link by employing both a static and a dynamic approach and using the indicators we developed in the previous section.

3.1. A non-existent static link between GVC participation and GVC value capture

Let us first begin with the static approach. The simplest and most effective way to apply it empirically consists of making, for several periods, regressions between the GVC participation and the value capture indicators to see if there is a correlation between the two. If it is the case, the sign, the magnitude and the reliability of the correlation should be studied.

Figure 3 shows the scatter plots between these two indicators for 59 countries[5] in four stages of the development of GVCs: 1995, 2000, 2005 and 2011[6]. Linear correlation lines[7] are drawn along with their corresponding correlation coefficients (R squared).

Figure 3: Scatter plots, linear correlation lines and R squared between GVC participation and GVC value capture rates for the years 1995, 2000, 2005 and 2011



It is clear from the shape of the scatter plots and the virtually null correlation coefficients that there is no static relation between GVC participation and GVC value capture.

[5] This is the number of countries for which there is available data to build the two indicators. These 59 countries account for at least 90% of global GDP, exports and imports in every year analyzed. The data are presented in section 6 below.

[6] There is available data to build the same scatter plots for years 2008, 2009 and 2010. The results obtained for those years are very similar to the ones presented in this paper.

[7] Although polynomic regressions offer higher R squared, the latter are not statistically significant for the years 1995, 2000 and 2005.

3.2. A non-existent dynamic link between GVC participation and GVC value capture

We will now study if there is a dynamic link between GVC participation and value capture. We will use the longest possible period that can be analyzed with the available data on trade in value added: 1995 to 2011. For each of the 59 countries for which it is possible to build the indicators described in the previous section, we calculate the absolute evolution of the GVC participation and the GVC value capture rates between 1995 and 2008[8]. Then we compare them to the sample's mean. If the evolution of the variable is higher than the average we classify it as "high" and if not we label it "low". Four possible combinations between high/low evolutions in GVC participation and GVC value capture rates emerge from this classification. Table 2 shows the percentage of countries of the sample that belong to each category.

Table 2: Distribution of the evolution of GVC participation and GVC value capture rates between 1995 and 2008

		GVC value capture evolution	
		Low	High
GVC participation evolution	Low	36%	29%
	High	20%	15%

Table 2 shows that the virtuous GVC integration case in terms of value capture (high increase in GVC participation coupled with high growth in the GVC value capture rate – lower-right cell-) is the least common one. Failed cases of GVC integration (lower-left cell) are just as common. Moreover, success cases are more frequent in countries that have integrated into GVCs less than the average (upper-right cell). Finally, the most common case is the failed low integration (upper-left cell). Nevertheless, the differences between the frequencies of each case do not suggest a general trend; they do not exceed 20 percent. The general conclusion to be drawn from Table 2 is that there is no general outcome in terms of value capture when countries integrate strongly or weakly into GVCs.

It is pertinent to wonder nonetheless if there is something like a "dominant strategy" regarding GVC participation. In other words: is it always more convenient in terms of value capture for a country to undertake a process of high (low) integration rather than a process of low (high) integration into GVCs? In order to answer this question we calculate the success rates of each of these strategies. This comes down to calculating what percentage of the countries with a low (high) GVC participation rate evolution obtained a high increase in their GVC value capture rates. The success rate obtained for countries with low GVC participation evolution is 45 percent while the one for countries with high GVC participation evolution is 43 percent.

[8] Although there is available data to do the same calculations from 1995 to 2011, we decided to cut-off the endpoint in 2008 in order to avoid including years in which the values of the two variables are highly altered because of the effects on world trade of the financial crisis, as explained in subsection 6.1.

We can conclude that, contrary to the prevailing view in the recent empirical literature (Kowalski et al., 2015; OECD et al., 2014, 2013; UNCTAD, 2013), larger involvement in GVCs does not necessarily bring about economic benefits. Nonetheless, the contrary is not true: smaller involvement in GVCs does not necessarily bring about economic benefits either. Moreover, neither strong nor weak evolutions (decreases in many cases) in GVC participation seem to be a better strategy to increase value capture. Therefore, the reasons for success and failure in terms of value capture are not to be found in the deepness of the GVC integration process but rather in qualitative differences between integration patterns.

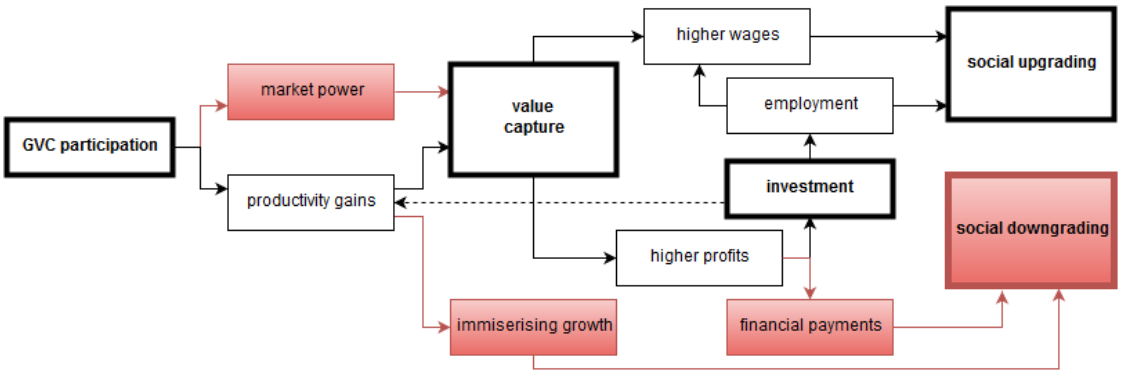
Additionally, although we believe that value capture is a major outcome of GVC integration to take into account, it is not the only one. Social and productivity outcomes should also be analyzed in order to grasp in a more comprehensive way the effects of GVC integration (Kowalski et al., 2015). Having this in mind, we will proceed in the next two sections to analyze both theoretically and empirically GVC *development* patterns.

4. Varieties of development patterns in GVCs

The mainstream story about GVC development patterns describes a *rosy scenario* where a country improves its economic and social situation as it increases its participation in global value chains (Kowalski et al., 2015; OECD et al., 2014, 2013; UNCTAD, 2013). The theoretical linkages underpinning this *rosy scenario* are generally not made explicit but are nonetheless derived from the comparative advantage argument about the benefits of specialization and the opportunities of knowledge spillovers (Romer, 1993). They could be summarized in this way: a country increasingly engaged in global value chains benefits from productivity spillover thanks to learning processes and cheaper inputs; this translates into greater domestic value-added and trickle-down into the economy through higher profits and investments, higher wages and higher tax collection, which altogether contribute to improved socioeconomic outcomes. However, as stated by (Milberg and Winkler, 2011), such a dynamic is far from automatic; economic upgrading is not a given and it is not necessarily associated with social upgrading.

Figure 4 proposes a stylized representation of GVC participation dynamics beyond the *rosy scenario*.

Figure 4 : GVC participation dynamics beyond the *rosy scenario*



First of all, it stresses that GVC related gains do not necessarily result from productivity improvements linked to specialization and/or knowledge spillovers. Indeed, GVC participation could lead to greater value capture thanks to the exercise of market power. Such market power could be related to economic barriers to entry or to an asymmetric political structure resulting in the protection of standards and intellectual property-rights. In such cases, benefits from GVC participation do not result from higher productivity but from the ability to extract rent from foreign actors, an idea already raised by dependency theorists (Palma, 1978). For example, the ability of global buyers to benefits from cheaper inputs could be completely disconnected from any productive improvement, in which case its overall impact will depend on the distribution and the uses of the gains (Milberg, 2008; Milberg and Winckler, 2013).

A second shortcoming of the *rosy scenario* is that it overlooks the possibility of immiserizing growth processes. Immiserizing growth occurs when an increase in quality or quantity of output resulting from productivity gains is more than compensated by diminishing prices, resulting in lower value capture. In such cases greater productive efficiency does not translate into greater economic gains but rather leads to social downgrading as previous uses of resources have been disrupted by the involvement in GVCs (Kaplinsky, 2004, 2000; Kaplinsky et al., 2002; Mohan, 2016).

A third limitation is that even in the case of value accrual thanks to productivity gains or market power, social upgrading is far from evident. Indeed, if these economic gains are captured by capital, they could fuel higher inequalities and limit the spillover effect that should increase the population's income. Moreover, higher profits do not necessarily translate into higher investment – they could result in higher financial payments, which means that the overall impact on employment is not straightforward. Thus, as a result of greater inequalities or unproductive uses of profits, greater value capture resulting from GVC participation can be associated with social downgrading. Positive socioeconomic outcomes necessitate that labor, which represents the bulk of the population, manages to capture part of the gains, either directly through higher wages or, indirectly, through tax-funded public welfare. For such an outcome to occur, the key mechanisms are a higher labor demand resulting from productive uses of profits and workers' ability to mobilize some structural and/or associational power (Selwyn, 2013).

This stylized analysis allows for a variety of GVC participation regimes summarized in Table 3. In the *rosy scenario* GVC participation translates into higher productive efficiency, greater value capture and positive socioeconomic outcomes. *Profit-led upgrading* means that higher participation is related to increased productive efficiency thanks to higher profits and investment. Social outcomes are negatively impacted by the diminishing wage share but the overall impact depends on the effects of investment on employment and wages. Overall social impact is also undetermined in the case of *Rentier's integration*, where greater GVC participation results in higher value capture as a result of market power exertion; social outcomes depend on the distribution of income between wages and profits and on the distribution of profits between investment and financial payments. *Immiserizing growth* indicates a configuration where productivity gains related to increased GVC participation and domestic investment do not result in higher value capture, nor social upgrading. We consider also the possibility of *Non-GVCs-led* dynamics where socioeconomic outcomes in terms of productive development and

social upgrading do not result from greater GVC participation nor increased value-capture.

Table 3: Varieties of GVC participation regimes

	ROSY SCENARIO	PROFIT-LED UPGRADING	RENTIER'S INTEGRATION	IMMISERIZING GROWTH	NON-GVCS LED DYNAMICS
GVC PARTICIPATION	+	+	+	+	-
VALUE CAPTURE/ADDITION	+	+	+	-	-
PRODUCTIVE DEVELOPMENT	+	+	-	+	?
SOCIOECONOMIC OUTCOMES	+	?	?	-	?

In the next section we will empirically test the existence of the differentiated GVC development patterns summarized in Table 3 in order to see if they are corroborated or not as well as if any other patterns emerge to be observed.

5. Data and indicators

As scholars have recently begun to point out, the link between GVC participation and domestic share of value added that has emerged at the empirical level as a standard of interpretation in terms of countries benefitting or not from GVCs is too narrow to capture the multi-dimensional processes involved in economic and social development more broadly (Milberg and Winkler 2013; Kowalski et al. 2015). At the theoretical level, among the standard types of upgrading in the literature – process, product, functional and chain upgrading – Kowalski et al. (2013: 32) note that "the process upgrading path above explicitly refers to efficiency while the product, functional and chain upgrading refer to the type of activities performed in value chains without an explicit reference to value creation or productivity". Yet this same study goes on to use per capita domestic value added as an indicator of productivity (33-36), rendering it theoretically impossible to account for any possible immiserizing growth or rent leakages in the mainstream GVC story (see Figure 4 above).

To disentangle these distinct mechanisms and achieve a more multi-dimensional picture of upgrading or downgrading in GVCs, we decided to complement GVC indicators in terms of participation and value capture with independent indicators to capture the dimensions of the growth of the productive structure of a country as well as to capture the social outcomes observed during the transformations wrought by the globalization of global value chains.

We will now provide information on the indicators chosen for each of these dimensions as well as the sources used to collect the data.

5.1. Value-added trade data

Data are available for value added trade from OECDStat's Trade in Value Added (TiVA) database for only 61 countries, plus a "rest of the world" observation which is too broad to be of use. As both of the GVC participation and value capture variables are indispensable to the analysis and dependent on the existence of value-added trade data, our data selection is necessarily limited to these 61 cases where such data are available. After gathering data for productive investment and our social upgrading indicators, discussed below, eight of these 61 cases were eliminated from our data set due to the non-availability of data present across more than one indicator, rendering statistical estimation unreliable. Two countries, Bulgaria and Latvia, were detected to be outliers in terms of investment rates. After trying several unsuccessful methods to deal with the outlying values of these two countries for that variable (replacing by the second highest value of the sample, replacing by the mean; eliminating them and estimating the missing values) we decided to exclude them from the sample. Indeed, when included, their particularly high scores in investment rates deformed the country-composition of the clusters by over emphasizing the weight of investment rates. We are therefore left with 51 countries in our data set, listed in full in the statistical annex.

The time period available in the same TiVa database are the years from 1995 to 2011. The starting point of 1995 follows the practice of other studies examining the evolution of the GVC era (De Backer and Miroudot, 2014; Timmer et al., 2014) and is also very close to the beginning of the era of the rapid take-off of GVC expansion in the early 1990s (Milberg et al., 2014, p. 151). We decided to cut off the end point at 2008 in order to avoid that the end point data would reflect the idiosyncrasies in patterns of world trade following the 2008 financial crisis, as world trade was severely restricted in 2009 and had not sufficiently recovered or settled into new observable trade patterns by the 2011 end point in the TiVA data (Donnan, 2016).

5.2. GVCs Indicators

Having already described the first two indicators in detail in section 3, here we will just recall that the GVC participation rate is defined as the sum of the non-primary product portion of domestic value added in exports plus intermediate imports over GDP, while the value capture rate is defined as the non-primary product portion of the domestic value added content of exports over the non-primary product portion of total exports plus intermediate imports. The sources for both variables come primarily from the OECD's TiVA database, with supplemental information on the share of primary products in a country's imports and exports taken from UNCTADStat, and GDP figures for the GVC participation denominator taken from the World Bank's World Development Indicators. More information on the sources for these variables is located in the statistical annex.

5.3. Productive investment

Gross capital formation was taken as an indicator of the scope of productive investment in an economy and its growth alongside the evolving relations with GVCs, a process distinct from whatever the trends may be with regard to value capture. The specific indicator is "total investment (percent of GDP)" from the IMF's World Economic Outlook database, defined as "the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector," all in current local currency.

The use of gross capital formation as a proxy for investment is generally taken as a more reliable indicator of long-term structural changes in productive capacity and capital accumulation (Duménil and Lévy 2013; Husson 2008) with more relevance for economic development than measures such as total factor productivity (Felipe and McCombie, 2003). The main limitation with the measure relates to the inclusion of residential investment which could make it difficult to distinguish real capital accumulation from real estate bubbles. Gross capital formation also does not take into account the original level of capital stock which can be assumed to vary enormously between countries. Both of these limitations are obviously to be kept in mind while interpreting the results.

5.4. Social outcomes

Due to the multifaceted nature of what might be involved in "social upgrading" (Milberg and Winkler 2013: 251), we chose four separate indicators that all capture important aspects of "wages, employment, and social standards" (238), without being directly reducible to each other.

Employment rate

The employment rate indicator was taken from the "labor force participation rate, total (% of total population ages 15-64)" data provided by the World Bank, defined as "the proportion of the population ages 15 to 64 that is economically active: all people who supply labor for the production of goods and services during a specified period" (World Bank, 2016).

This indicator was chosen instead of a simple unemployment rate figure because of the huge problem of informality in developing countries, making a cross-country comparison of unemployment rates of dubious value. To take an example, India has a mere 4.1 percent unemployment rate in the same World Bank database for 2008, and 4 percent for 1995, performing significantly above the average in both years as well as for the percentage change between the two years. Yet the LABORSTA (ILO, n.d.) database has 84 percent of India's non-agricultural workforce in informal employment in 2009. While a reliable measure of total formal employment as a percentage of the working age population would therefore be ideal, the lack of sufficient data in the ILO database or elsewhere makes the World Bank's "labor force participation rate" the best available indicator (India scores, more realistically, significantly below average with this indicator).

Median income

Median income was chosen as a measure of the improvement or lack thereof in real income for the median individual in a given country's income distribution. It was chosen for this purpose as a more precise measure than average income, which is subject to relative variations in top incomes. The data comes principally comes from combining two sources: the Luxembourg Income Study for countries where data is available, and the World Bank's PovcalNet database for the remainder of countries. The methodology of combining the two sources follows that of the Pew Research Center (Kochhar, 2015), and has also been employed in a similar manner by (Hellebrandt and Mauro, 2015). Rates of change were calculated by putting both the 1995 and 2008 figures in constant 2005 local currency units. The final 2008 value computed in order to create the composite variable (see methodology section below) was put in 2011 PPP dollars for international comparability. See the annex for further details, including the eight countries where other data sources were used for lack of information in the LIS and PovcalNet databases, including two of which needed to be estimated by the NIPALS method.

Gini coefficient

The Gini coefficient was used as a general measure of inequality in a country. Since, unlike the other variables, a lower Gini score reflects a better outcome (in this case, lower inequality), the Gini score was accordingly adjusted in order to vary in the same direction as the other variables (so that a higher score reflects a better outcome). In the case of the rate of change, this was done by the formula: (2008 Gini / 1995 Gini) – 1. In the case of the 2008 value for the composite measure (see below), this was done by the formula: 100 – 2008 Gini.

In terms of the calculations to get the Gini coefficients, these were in the vast majority of cases computed with the same income distribution data that provided the median income values (principally the Luxembourg Income Study and PovcalNet data: see annex for details).

Labor's share of income

As the Gini coefficient is unable to distinguish between trends in primary and secondary income flows, labor's share of income was also taken as a measure of the balance of power between capital and labor in the production process itself. The data were taken from OECDStat's "labour income share ratios – total economy" for most OECD countries and from the data set constructed by Katharina van Treeck that measures labor's share in low and medium income countries (Trapp, 2015). Since the database that van Treeck constructed is more robust and finely attuned to the reality of extensive self-employment in many developing economies, data were taken from this data set whenever they were available in both data sets. The remainder of countries were taken from OECDStat. In the case of four countries where data was not available in either data set, the values were estimated using the NIPALS method (see annex for further details).

5.5. Summary of the indicators

Table 4 succinctly summarizes the above described indicators used in our empirical analysis as well as the sources from which each of them were retrieved or from which they were built.

The data described was transformed in order to perform the PCA. For every variable, the original data corresponds to the percentage increase between 1995 and 2008. Yet, using merely percentage increases would have made comparisons between countries misleading since the starting and final values of variables vary significantly between countries and, therefore, relative increases are not comparable when we take into consideration what they represent. For example, for China the variable INVESTMENT_RATE increased by only 8% during the above-mentioned period, which is little more the sample's mean. Nevertheless, an 8% increase in investment in a country like China, which had an astonishing average investment rate of 36.5% of GDP between 1995 and 2008, represents a considerable increase: it is difficult to increase investment by much when investment rates are already huge. The same argument can be held for the other variables. For this reason, we decided to use an index that weights percentage increases by the end value of each variable, i.e., its value in 2008. In order to conserve a reasonable equilibrium between the two, we decided to weight each of them by 50%. Since percentage increases and end values are expressed in different units, we first standardized both of them and then did a mean of the two to obtain the index. Thus, for any variable X we have:

Equation 3: General equation to calculate the indexes used in the PCA

$$INDEX\_X = ST(VAR\_X\_DELTA) * 0.5 + ST(VAR\_X\_2008) * 0,5$$

Where ST() stands for the standardization of the value between brackets, "VAR_X_DELTA" is the percentage increase between 1995 and 2008 of variable X and "VAR_X_2008" stands for the value of variable X in 2008.

In order not to over-represent social variables in our analysis, we chose to create a composite "SOCIAL_INDEX" variable that contains the four above-mentioned social variables. Indeed, had we included the four social variables in the PCA, the social dimension of the analysis would have accounted for most of the variables in the PCA (4 out of 7), which would have over-emphasized the importance of social outcomes in GVC development patterns. Since we wanted to give each of the dimensions of integration patterns summarized in Table 4 (participation, value capture, investment and social) the same weight, a composite social variable seemed like the best choice. In order to build the indicator, we first created an index for each independent social variable following the methodology described in Equation 3. Then, we did a mean of the 4 social variables that resulted in the composite variable "SOCIAL_INDEX" used in the PCA. It is worth noticing that alternative PCAs that included the four separate social variables instead of a composite social variable where performed and, in those cases, median income, gini and labor share where correlated and represented in the same side of the same axis, though it was not the case for employment rate in all of the alternative PCAs. This confirmed our choice of using a composite social variable.

Table 4: Criteria of development patterns. Definition and sources

	Indicators	*Sources*	*Indexes*
INVESTMENT	Investment/GDP	IMF World Economic Outlook	INVESTMENT_INDEX
VALUE CAPTURE	See above formula	OECDStat / UNCTADStat	VALCAPT_INDEX
SOCIAL	Median Income Employment rate Wage share Gini	LIS / PovcalNet World Bank OECDStat, Trapp 2015 LIS / PovcalNet	SOCIAL_INDEX
GVC PARTICIPATION	See above formula	OECDStat / UNCTADStat / World Bank	PART_INDEX

6. Principal component analysis

6.1. Outline of the evolution of the variables

Before performing the principal component analysis (PCA), we take a look at the direction in which the analyzed variables evolved in order to provide a first glance of the general trends.

Table 5 : Distribution of country evolution and mean percentage change between 1995 and 2008 for each indicator

	PARTICIPATION	VALUE CAPTURE	INVESTMENT RATE	LABOR SHARE	EMPLOYMENT RATE	GINI (-1)	MEDIAN INCOME
Percentage of countries with positive evolutions	**84%**	27%	**67%**	22%	**76%**	53%	**88%**
Percentage of countries with negative evolutions	16%	**73%**	33%	**78%**	24%	47%	12%
Mean percentage change	29%	-4%	10%	-6%	3%	0%	37%

Table 5 shows some general trends in the variations of the raw variables analyzed. As expected, participation in GVCs increased for the vast majority (84%) of the countries and on average by 29%. On the contrary, value capture decreased for 73% of them, although the mean decrease is negligible (-4%). The investment rate, the employment rate and especially median income increased for most of the countries and on average.

It is worth noticing that the two variables chosen to measure inequality, the labor share and the Gini index, tell different stories. Measured in terms of labor share, we could say that inequalities increased in 78% of the countries and rose by 6% on average, whereas using the Gini coefficient, inequalities rose in roughly half of the countries and did not evolve on average. This reinforces our decision to include both variables to measure inequality.

6.2. Methodology

The main objective of this paper is to show both theoretically and empirically that GVC integration patterns are not homogenous but rather diverse in terms of development. This means that integration into GVCs, be it slow or fast, can bring about different combinations of outcomes in terms of value capture, investment and social variables. In this sense, and following a critical realist approach (Lawson, 1997), we consider that regressions are not suited to show this diversity. This is because, when applied to heterogeneous countries, they assume that the relations between variables are the same for all of them, which is exactly what we argue against. The lack of correlation between GVC participation and value capture shown in section 4 exhibits the limitations of traditional regressions to capture what we want to capture.

On the contrary, a principal component analysis (PCA) is perfectly suited to capture heterogeneity of behaviors between variables (participation, value capture, investment, etc.) among groups of observations (countries). We will therefore perform a PCA and, based on the results, follow up with a cluster analysis that will make the empirical identification of differentiated GVC integration patterns possible.

It is also worth mentioning that when the PCA was performed with only percentage increases as the input variables, the variable composition of the axes remained very similar to the one described in this paper. This shows that the PCA is robust and that the use of the above-mentioned index only affects the position of the countries along the axes.

Three axes were retained in the PCA for three reasons. First, following the Kaiser criterion (Kaiser, 1960), axes F1, F2 and F3 were the ones with eigenvalues above 1. Second, while the decrease in eigenvalues from F1 to F3 where smooth, the decrease from axis F3's eigenvalue to axis F4's was sharp, which indicates that axes F1 to F3 should be retained (see the Annex). Third, taking axes F1, F2 and F3 provided significant correlations (over 0,76) between axes and at least one of the variables. Had we taken only two, the variable SOCIAL_INDEX, would have been virtually uncorrelated with the axes while it is very strongly correlated (0,97) with axis F3.

No rotations were applied because the information concentrates in the first three axes showed virtually no increase when rotations where tested.

6.3. Results

The information contained in the three retained axes concentrated 83.14% of the variables' information.

Figure 5 shows the correlation circle on axes F1 and F2 that resulted from the PCA, while Table 6 shows the coordinates of the variables for each axis. Particularly positive or negative coordinates are shown in bold[9].

Figure 5: Correlation circle on axes F1 and F2

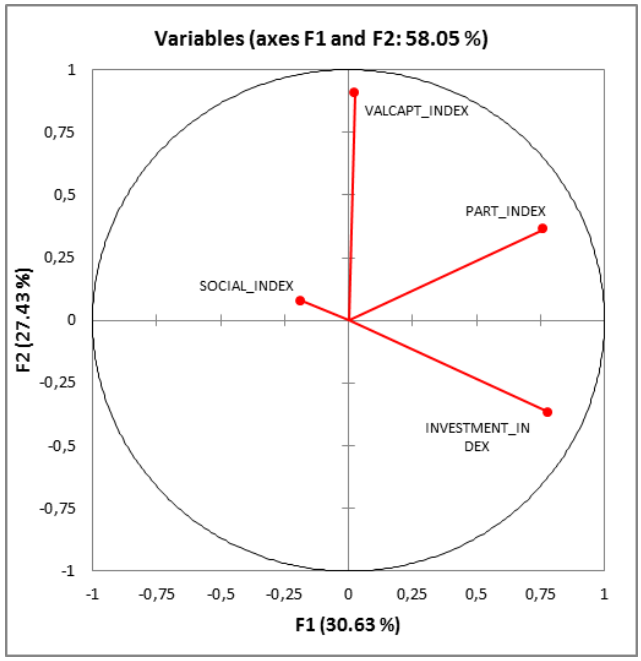


Table 6: Factor loadings of each variable for axes F1, F2 and F3

	F1	F2	F3
PART_INDEX	**0,76**	0,36	0,20
VALCAPT_INDEX	0,03	**0,91**	-0,15
INVESTMENT_INDEX	**0,78**	-0,37	0,04
SOCIAL_INDEX	-0,19	0,08	**0,97**

Table 6 shows that the right side of axis F2 is strongly characterized by the variable VAPCAPT_INDEX and that the variable SOCIAL_INDEX is highly represented on one side

[9] As the reader will notice by observing the lower-right cell of Table 6, the variable SOCIAL_INDEX is very highly correlated with axis F3. The variable factors map being two-dimensional, this correlation cannot be visualized in Figure 5.

of axis F3. Both PART_INDEX and INVESTMENT_INDEX are associated with the right side of axis F1. Although these two variables have coordinates of 0.36 and 0.37 respectively in axis F2, they should nonetheless not be interpreted as being associated with axis F2, since, as shown in Table 7, the share of their information contained in axis F2 is small.

Table 7: Contributions of the variables to axes F1, F2 and F3 in percentage points

	F1	F2	F3
PART_INDEX	**47,4**	12,0	4,1
VALCAPT_INDEX	0,1	**75,2**	2,3
INVESTMENT_INDEX	**49,7**	12,2	0,1
SOCIAL_INDEX	2,8	0,6	**93,5**

Some preliminary conclusions can be made before analyzing the positions of the countries in the PCA through a cluster analysis. First, the fact that PART_INDEX VALCAPT_INDEX and SOCIAL_INDEX are represented along different orthogonal axes indicates that these three variables are independent of each other. This confirms the results of section 4. In other words, it seems like there is no link between GVC participation, value capture and social outcomes. Second, INVESTMENT_INDEX and PART_INDEX being both associated with the right side of axis F1 indicates that, in general terms, countries that have increased their participation indexes the most are also the ones that have increased their investment indexes the most. Bearing in mind that the indexes are made of the percentage increases of the variables and their final values in equal parts, this can be interpreted in two non-mutually exclusive ways: countries that have most increased their participation in GVCs are either countries that have also seen the largest increases in their investment rates in percentage terms and/or they are countries that had large investment rates in 2008.

7. Cluster analysis

7.1. Methodology

A first cluster analysis was performed applying the agglomerative hierarchical clustering (AHC) method to the coordinates of each observation in the three axes retained. Three classes were found to be statistically similar. We then performed a cluster analysis using the k-means method on the coordinates of the observations in axes F1, F2 and F3 with an open rage of classes from 1 to 5. The result was again 3 classes. Therefore, we chose to perform the same k-means clustering to obtain 3 classes, which had been tested to be the statistically reliable number of classes. Tests in which we performed the k-means clustering to obtain 4 and 5 classes gave us results with very uneven numbers of observations by classes and in many cases blurry variable compositions of classes, corroborating that 3 classes was the right choice.

7.2. Results

As said in the previous subsection, a k-means clustering was performed on the coordinates of the observations in axes F1, F2 and F3 in order to obtain 3 classes.

Table 8 shows the country composition of each class along with the number of countries in each, the sum of weights, within-class variance, and minimum, average and maximum distance to centroid for each class.

Table 8 : Country composition of the classes and statistical results by class (World Bank countries abbreviations)

Class	1	2	3
Sum of weights	14	16	21
Within-class variance	1,56	1,89	2,00
Minimum distance to centroid	0,40	0,52	0,37
Average distance to centroid	1,11	1,27	1,23
Maximum distance to centroid	2,40	2,01	2,74
	ARG	AUT	CHN
	AUS	BRA	CRI
	BEL	CHE	CZE
	CAN	COL	EST
	CHL	DEU	FIN
	DNK	FRA	HRV
	ESP	GBR	HUN
	GRC	ISR	IND
	IDN	ITA	IRL
	ISL	JPN	KOR
	NOR	KHM	LUX
	NZL	NLD	MEX
	PRT	PHL	MYS
	RUS	SWE	POL
		TUR	ROU
		USA	SVK
			SVN
			THA
			TUN
			VNM
			ZAF
Number of observations	14	16	21

We shall now study the variable composition of each class in order to interpret the characteristics of each of these 3 country groupings in terms of GVC development patterns.

In order to do so, we calculated the mean value of the 4 variables used in the PCA for each class and compared them to the sample mean. Given that the raw variables were standardized in order to build the indexes, the mean is equal to 0 for each index. Figure 6 shows the results of these calculations in a radial graph.

Figure 6: Mean value of each variable by class and for the sample

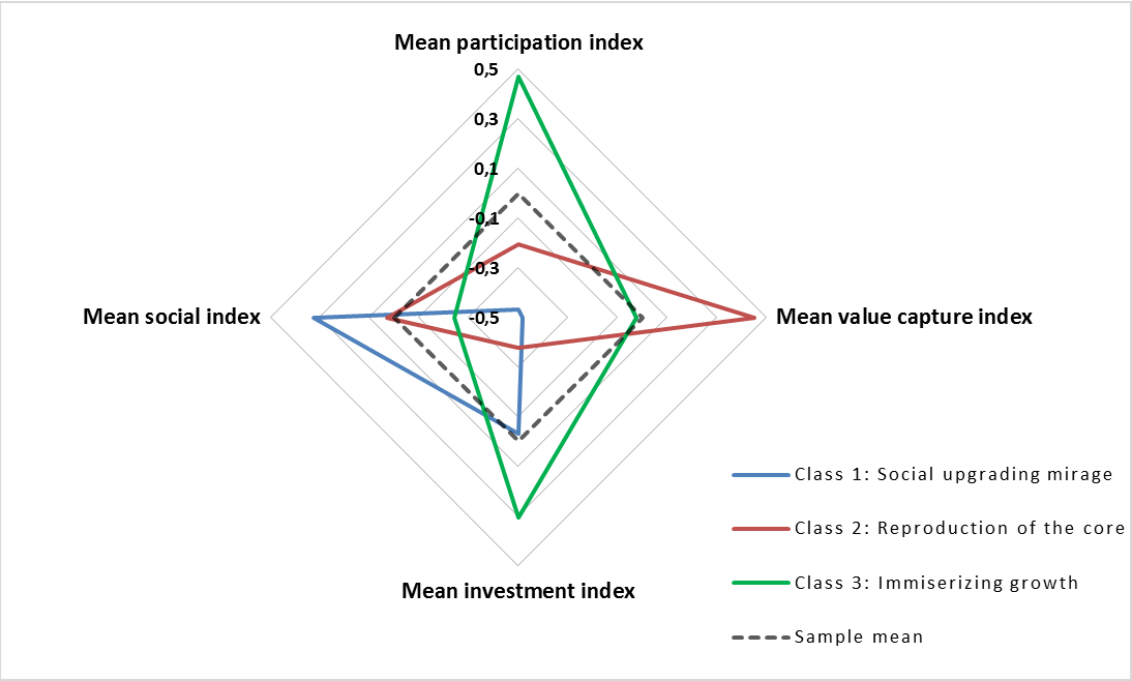


Figure 6 shows, class 1 is characterized by a very small increase in GVC participation and value capture, an average increase in investment and a high increase in social variables. Taking into account the country composition of the class, two different trajectories that converge into the same GVC development pattern can be construed.

The first one corresponds to a "GVC resource curse" and applies to countries like Argentina, Australia, Canada, Chile, Indonesia, Iceland, New Zealand, Norway and Russia. Here the countries are net primary commodity exporters[10] that benefited from the historically exceptional increase in the international prices of commodities. Given the definition of our indicators, this implies a disengagement from GVCs and a loss in value capture coming from GVCs. Investment did not particularly evolve because of this dynamic but, on the contrary, the policies and social dynamics that took place between 1995 and 2008 contributed to the use of these commodity-related income gains to obtain social improvements in terms equality, gains in median income and employment.

The second trajectory found in this first cluster is that of peripheral European countries that benefited up to the crisis from foreign financial inflows which allowed temporary social improvements (Stockhammer et al., 2016). These countries lagged behind in GVC participation and economic upgrading, which led to underperformance in terms of GVC-related value capture. Yet, this brought about a flow of financial-related income that was distributed in a way that median income increased and inequalities decreased. In the case of Greece, Spain and Portugal, they benefited from capital inflows during their integration into the European Union and the Eurozone and, by that means, were able to

[10] UNCTAD data presented for the early 2010s in "Commodity dependency" (Economist, 2015) http://www.economist.com/blogs/graphicdetail/2015/08/commodity-dependency

undergo a process of social upgrading. Nonetheless, this process adversely affected their competitiveness and resulted in a lag in GVC participation and economic upgrading. The severe economic crises these countries are undergoing since 2008 illustrate the mirage-like quality of the non-GVCs led social upgrading path of class 1.

Class 2 is characterized by medium-low scores in GVC participation and investment rates coupled with an average score in the social variable and a very positive evolution in terms of value capture. The countries that constitute this class are mainly developed countries[11]. This suggests a trajectory characterized by a slow increase in GVC participation but in which participation was increasingly concentrated in the tiers of value chains that are able to capture more value. Given that these countries have been developed for decades if not centuries, they already had developed productive structures that allowed them to achieve highly profitable positions in GVCs without a sharp increase in investment. A comparison between the average social index score of these specific countries (Figure 6) and the average evolution and the distribution between positive and negative evolutions of the individual social variables for the sample as a whole (see Table 5) suggests that the populations of these countries benefited from an increase in median income compatible with their sharp increase in GVC-related value capture but that employment did not increase much and inequality did not change or even increased, depending on the case; hence the average social index score. In this sense, we can think of this dynamic as a reproduction of the core trajectory: the most developed countries in 1995 did not increase their GVC participation as much as others during the globalization boom, yet they were able to capture more value than the others.

Class 3 is characterized by very high scores in GVC participation and investment rate, an average score in value capture and low scores in social terms. The countries that compose this class are developing countries mainly from Asia and Eastern Europe that in many cases were starting to undergo a process of reintegrating into capitalism after decades of socialist regimes. Their economies opened sharply and they joined the globalization boom by participating strongly in GVCs, which, consequently, implied sharp increases in their investment rates in countries that had weak productive structures in 1995. Value capture decreased slightly in contrast to countries of class 2 ("reproduction of the core"). Moreover, in terms of the social upgrading this GVC development pattern was not beneficial: inequalities increased more than in any other group of countries, median income saw an average increase despite the strong integration process they underwent and employment evolution was virtually null, clearly the slowest compared to the other two classes.

[11] Indeed, some of the countries in this class (Brazil, Colombia, Cambodia, Philippines and Turkey) are developing countries with heterogeneous development patterns. Their belonging to class 2 illustrates the limitations of cluster analyses made on observations' factor scores in a PCA. The grouping and its consequent class variable composition reflect general trends in the observations of the sample, but each class' characteristics cannot be interpreted straightforwardly to be fully representative of every observation (country) of the class concerned. Nevertheless, the homogeneity of the development pattern between the developed countries of class 2 that is explained in this section accounts for two thirds of the observations of the class, which makes our characterization of the "reproduction of the core" development pattern reliable. Moreover, the reader should bear in mind that, as explained above, the three groups clustering choice was verified to be the most prudent one.

8. Discussion

Our PCA and cluster analyses indicate three main development patterns in GVCs between 1995 and 2008: *Social upgrading mirage*, *Reproduction of the core* and *Immiserizing growth*. These observed patterns could be contrasted to the diversity of potential GVC participation regimes identified at the theoretical level (Table 3 and Table 9).

Table 9: The complementarity of observed development patterns

	REPRODUCTION OF THE CORE *RENTIER'S INTEGRATION*	IMMISERIZING GROWTH	SOCIAL UPGRADING MIRAGE *NON-GVCS LED DYNAMICS*
GVC PARTICIPATION	+/-	+	-
VA CAPTURE	+	+/-	-
PRODUCTIVE DEVELOPMENT	-	+	+/-
SOCIOECONOMIC OUTCOMES	+/-	-	+

The first striking fact is the absence of the *rosy scenario* and the *profit-led upgrading* patterns, which suggests that the preferred option of the mainstream literature might not be as relevant as generally admitted.

A second element sheds an interesting light on these absences: the apparent complementarity between the three regimes revealed by the polarization in each of the dimensions of our typology, which suggests that development patterns in GVCs need to be understood as constitutive parts of a global process of uneven development. The overall picture that emerges is that of a *reproduction of the core* where value capture is disconnected from productive development measured in terms of investment. The counterpart of this privilege of the core is a process of *immiserizing growth* in peripheral countries where rapid insertion in GVCs is related to a marked effort in terms of productive development but poor social outcomes. Interestingly, the best social outcomes seem related to a relative insulation from GVC dynamics. However, we called this configuration a *Social- upgrading mirage* because it rests mostly on external - non-GVCs related - conditions of possibility which are, on the one hand, the commodity boom and, on the other hand, financial inflows.

With this overall picture in mind we can come back to our initial conception of GVCs as a specific form of the division of labor. Such a conceptualization allows for an original understanding of the diversity and complementarity of uneven development patterns along value chains. These uneven development patterns typically result from the fact that GVCs delineate transnationally fragmented labor processes, often dispersed among formally independent entities, that are nonetheless to some degree economically unified

under a dominant locus of valorization. Market power positions reflect some degree of control over labor processes that descends along the chains and allows value capture at considerable geographical remove from the countries where productive development takes place. This focus on fragmented-unified valorization processes also sheds a new light on social outcomes. They cannot directly be deduced from GVC participation and can only be understood if one takes into account the distribution of capitals' powers along the chain in addition to other dimensions such as the institutional set of constraints and regulations or the position of labor at the point of production.

Conclusion

In order to overcome the disjuncture between theoretical development in GVC literature and macro, multi-country measurements, this contribution presented an original theoretical conceptualization of GVCs as a form of the division of labor, some new indicators of GVC participation and value capture, new stylized facts about the relation between value capture and GVC participation and a preliminary empirical inquiry into the different patterns of development along GVCs.

Focusing on GVC dynamics at the macro-level, our PCA and cluster analysis indicate three main patterns of development in GVCs between 1995 and 2008: *Social upgrading mirage*, *Reproduction of the core* and *Immiserizing growth*. Contrary to the mainstream narrative about the uniformly positive effects of GVC participation, we show a more nuanced reality where gains from GVC participation are unevenly distributed between and within countries and points to the complementarity of the diverse GVC development patterns reflecting the specificities of the global division of labor within value chains.

This paper thus identifies economic mechanisms that are difficult to disentangle through case studies and do not suffer from the selection biases inherent to such a methodology. We hope that it will contribute to new avenues for theoretical discussions and empirical inquiries within the GVC community. In such a perspective, one should bear in mind that two crucial dimensions of the problem are missing in this analysis. The first one is financialization dynamics, which are relevant at the level of the uses of profits by lead firms and as a countervailing force of productive and social dynamics. We have only alluded to it here, but it needs to be properly articulated with the analysis of GVC development patterns. The second is the environmental dimension. Indeed, the uneven distribution of ecological costs of production along the chains is a crucial aspect of development patterns and their respective prospects.

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Annex

The annex is divided into two parts. The first one refers to the construction of the raw indicators analyzed in section 4 and with which the indexes used as variables for the PCA were built. Information about sources, data treatment and all the methodological choices made to build the database are detailed for every raw indicator. The second part offers more statistical outputs of the PCA that have not been included in the paper.

1. Raw indicators

1.1. Country coverage

Regarding country coverage, the following eight cases were excluded from our data set despite being available in the OECD TiVA data set, owing to the non-availability of data across more than one variable used in the social upgrading field: Brunei Darussalam, Cyprus, Hong Kong, Lithuania, Malta, Saudi Arabia, Singapore, and Taiwan. A full list of countries in our data set is found below in the "Social Indicators Data Table."

1.2. GVC participation

The formula to determine the GVC Participation rate, as mentioned in sub section 3.1 of the paper, is:

$$\frac{(DVA\ in\ X) * (1 - ppX) + ipM * (1 - ppM)}{GDP}$$

Where "DVA in X" is domestic value added in gross exports, "ppX" is the share of primary products in total exports, "ipM" is gross imports of intermediate products and "ppM" the share of primary products in total imports

Domestic value added content of gross exports and gross imports of intermediate products are taken from OECDStat's Trade in Value Added (TiVA) database, October 2015 version, in US dollars. The shares of primary products in total exports and imports are taken from UNCTADStat. Primary commodities, precious stones and non-monetary gold (SITC 0 + 1 + 2 + 3 + 4 + 68 + 667+ 971) as total volumes in US dollars of exports and imports for each country were made into shares by dividing by total exports and

imports in US dollars from the same database. GDP figures are from the World Bank's "GDP at market prices (current US$)" variable in its World Development Indicators data set, and are given in current prices converted into US dollars through the exchange rate.

For this indicator there were no missing data points, nor was there a need for any additional treatment of the data, with the exception of the treatment of the outlier Cambodia, whose rate of change between 1995 and 2008 was more than 4 times higher than the second highest value in the entire data set. The percentage change between 1995 and 2008 for Cambodia was therefore replaced by the second highest variable in order to not overly skew the results.

1.3. Value capture

The formula to determine value capture or the GVC gain rate, mentioned in subsection 3.2 of the paper, is:

$$\frac{(DVA\ in\ X) * (1 - ppX)}{(DVA\ in\ X) * (1 - ppX) + ipM * (1 - ppM)}$$

Where "DVA in X" is domestic value added in gross exports, "ppX" is the share of primary products in total exports, "ipM" is gross imports of intermediate products and "ppM" the share of primary products in total imports

The sources for domestic value added content of gross exports, the share of primary products in total exports and imports, and gross imports of intermediate products are the same as used to construct the GVC participation indicator.

For this indicator there were no missing data points, nor was there a need for any additional treatment of the data.

1.4. Productive investment

For this indicator there were no missing data points, nor was there a need for any additional treatment of the data, with the exception of the treatment of the outliers Bulgaria and Latvia. Due to an unusually low starting point in 1995, which is highly likely to be an underestimate, Bulgaria would have had a rate of change more than four times the second highest value, Latvia, itself already 41.5 percent higher than any other value in the data set. After trying several methods to deal with these outlying values (replacing by the next highest value of the sample, replacing by the mean; eliminating them and estimating the missing values) that nonetheless continued to over-weight the role of the variable INVESTMENT_INDEX in the PCA and, especially, in the country-composition of the classes that emerged from the clustering based on the PCA, we decided to exclude both Bulgaria and Latvia from the sample.

1.5. Social Indicators

Employment rate

For this indicator there were no missing data points, nor was there a need for any additional treatment of the data.

Median income

As mentioned in the paper, the method of coming up with median income figures for such a wide range of countries follows exactly the methodology employed by the Pew Research Center (Kochhar 2015). This entails combining Luxembourg Income Study data, all of which is disposable household income data, with PovcalNet data for countries unavailable in the Luxembourg Income Study data set, some of which is income and some of which is consumption data, according to the survey year and country.

PovcalNet data came from the query of the database by Dykstra, Dykstra and Sandefur (2014) where "the population of each country is divided into 10,000 equal-size groups, where each group represents 0.01% of a country's population. The groups are ranked by per capita income or consumption" (Kochhar 2015). The median income score was taken as the 50^{th} percentile of these 10,000 equal-size groups, which is not a precise median at the individual level but the closest thing available for many developing countries (Kochhar 2015). For greater comparability the Luxembourg Income Study data was treated in the same way, splitting the distribution into 10,000 equal size groups and taking the 50^{th} percentile of these groups. Since the PovcalNet data is given at the level of individuals rather than households or equivalized scales, the Luxembourg Income Study data was also taken at the individual level by dividing each observation's disposable income total (which is at the household level) by the variable "number of household members" in order to transform the individual household observation into multiple numbers of individual observations (as many as exist in a given household) with the same individual income level (that of their household divided by its number of members). As with the methodology of the Pew Research Center, this method is not able to capture economies of scale inside households, and thus likely overestimates the real income gap between wealthy countries with smaller family units and poorer countries with larger ones (Kochhar 2015). This is the main data limitation for the median income variable, along with the potential incompability of taking consumption data in the countries where it was presented and income data in others. Nonetheless, combining income and consumption data for cross country comparisons in this manner is common in the literature (Birdsall, 2010; Hellebrandt and Mauro 2015). Furthermore, since both of the listed limitations barely enter the picture when the rate of change inside one country is measured between two years, rather than the comparison between countries at a given year's values, these limitations are strongly mitigated in our analysis since the variable that eventually entered our principal component analysis is 50 percent determined by the rate of change in a given country between 1995 and 2008.

In all cases for both the median incomes and the GINI indicators, data was taken as available as close as possible to the years 1995 and 2008, up to 3 years before or after

the benchmark years (i.e. from 1992 to 1998 and from 2005 to 2010). For the median income, if the reported data came from one of the surrounding years that was not the benchmark year, it was extrapolated to the benchmark year following Kochhar's method of assuming an annual rate of change equal to 70 percent of the change in real household consumption expenditures, with the data taken from the World Bank's "household final consumption expenditure per capita growth (annual %)" variable in its Data Catalog.

All data was put in 2005 constant local currency prices in order to compare the rate of change between 1995 and 2008, and the 2008 values were put into 2011 international PPP dollars in order to have a comparable figure between countries for the 50 percent weight with final values that entered the principal component analysis. These conversions were done using the World Bank's International Comparison Program 2005 PPP to local currency convertors where applicable (that is, for all PovcalNet data since it is reported in 2005 PPPs) and the World Bank data catalog's "consumer price index (2010=100)" both to put non-PovcalNet data in 2005 local currency units and to bring all 2008 data to 2011 local currency units in order to use the 2011 International Comparison Program PPP (Table R3, "individual consumption expenditure by households") convertors to put the values into 2011 PPP dollars. Where data was missing from the World Bank's consumer price index, the IMF's World Economic Outlook Database (updated on January 19, 2016) was used for the same purpose (this was the case for Argentina, Chile, and China).

In addition to these adjustments, other adjustments that were necessary included multiplying the PovcalNet figures by 12 (they are reported as monthly estimates) to get a yearly estimate comparable with the Luxembourg Income Study data, and using Eurostat's "former euro area national currencies vs. euro/ECU – annual data" convertors in cases where the reported data of countries was done in the old national currency of countries who now use the Euro (and thus the 2011 PPP convertor is in Euros). This was the case for the 1995 values for Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, and Spain, in order to put them in 1995 local Euros before bringing them to 2005 Euros to make the rate of change calculation. It would have been done for the 1995 value with Slovenia as well, but the result gave an unreliable estimate (a 30% decrease in median income between 1995 and 2008), so the rate of change was estimated instead (see below table) while the Euro reported 2008 value was deemed reliable. Late Euro adopters Estonia and Slovakia were treated differently, since not only their 1995 values but also their 2008 values were reported in their pre-Euro local currency. Their 1995-2008 rates of change were therefore calculated by leaving both years in 2005 pre-Euro local currencies, while their 2008 final values were converted to Euros in order to make the 2011 PPP estimate.

If reported values for any countries were available for both 1995 and 2008 from both the Luxembourg Income Study and the PovcalNet database, the LIS data was chosen as more consistent with the rest of the dataset. The only exception here is Mexico, where there was a large difference between the numbers given by the LIS and the PovcalNet database concerning the rate of change between 1995 and 2008 – an astronomical 122 percent increase with LIS data versus a below the mean 25 percent increase with PovcalNet data. Given what is known about Mexican real income stagnation during this period (CONEVAL 2014: 51), the LIS data was deemed unreliable (in all likelihood the LIS 1995 figure is far too low, since the 2008 values themselves in 2011 PPP dollars are

not very different, PovcalNet's are even a bit higher -- $2,556 PPP versus $2,492 PPP). The PovcalNet data were therefore used uniquely in Mexico's case when both PovcalNet and Luxembourg Income Study data were available.

If values were not available for both years in either the Luxembourg Income Study or the PovcalNet database, the best alternative estimate consistent between the two years was sought, and statistical estimation was used in the cases where nothing could be found (some combination of finding other sources or using statistical estimation occurred for only 9 out of 51 countries). Table 10 below describes the data used for every country for both median incomes, Gini values, and labor's share of the income, along with the years of the reported data (the column is for the median income and Gini variables, where there was more variation, while any variation from 1995 or 2008 for labor's share is noted inside the labor's share column itself) and whether there were any complications and, if so, how they were handled:

Table 10 : Social indicators data table

Country	Country code	Median income source	Type of data / complication	GINI Source	Years of reported data	Labor's Share Source
Argentina	ARG	PovcalNet	Income	Same as median	1995, 2008	Trapp 2015 (2008 not available, 2007 used)
Australia	AUS	Luxembourg Income Study	Income	Same as median	1995, 2008	OECD Stat
Austria	AUT	UNU Wider – WIID 3.3	Income (Available for 1995 only in the LIS, but not taken since it is available for both years from the same source from the European Commission gathered by the WIID database, which makes the rate of change calculation more reliable)	Luxembourg Income Study is available for 1995 but not for 2008. For 2008, it is listed at 27.8 by two different data sets gathered by the "all the Ginis" (Milanovic) database, with a close number from yet another in 2005 and no far away values, so the 27.8 figure was taken.	1995, 2006 for median income. 1995, 2008 for GINI.	OECD Stat
Belgium	BEL	UNU Wider – WIID 3.3	Income (Available for 1995 only in the LIS, but not taken since it is available for both years from the same source from the European Commission gathered by the WIID database, which makes the rate of change calculation more reliable)	Luxembourg Income Study is available for 1995 but not for 2008. For 2008, it is listed at 28.5 by two different data sets gathered by the "all the Ginis" database, with a close number from yet another in 2005 and no far away values, so the 28.5 figure was taken.	1995, 2006 for median income. 1995, 2008 for GINI.	OECD Stat
Brazil	BRA	PovcalNet	Income	Same as median	1995, 2008	Trapp 2015
Cambodia	KHM	PovcalNet	Consumption	Same as median	1994, 2008	No data available
Canada	CAN	Luxembourg Income Study	Income	Same as median	1994, 2007	OECD Stat
Chile	CHL	PovcalNet	Income	Same as median	1994, 2009	Trapp 2015
China	CHN	PovcalNet	Consumption	Same as median	1996, 2008	Trapp 2015
Colombia	COL	PovcalNet	Income	Same as median	1996, 2008	Trapp 2015
Costa Rica	CRI	PovcalNet	Income	Same as median	1995, 2008	Trapp 2015
Croatia	HRV	PovcalNet	Consumption	Same as median	1998, 2008	Trapp 2015 (1995 and 2008 not available; 1996 and 2007 used)
Czech Republic	CZE	Luxembourg Income Study	Income	Same as median	1996, 2007	Trapp 2015 (2008 not available, 2005 used)
Denmark	DNK	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
Estonia	EST	Luxembourg Income Study / PovcalNet	1995 value from PovcalNet, consumption; 2008 value from Luxembourg Income Study, income	Same as median	1995, 2007	Trapp 2015 (2008 not available, 2005 used)
Finland	FIN	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
France	FRA	Luxembourg Income Study	Income	Same as median	1994, 2010	OECD Stat
Germany	DEU	Luxembourg Income Study	Income	Same as median	1994, 2007	OECD Stat
Greece	GRC	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat (1995 value is an estimated value by OECD Stat)
Hungary	HUN	Luxembourg Income Study	Income	Same as median	1994, 2007	Trapp 2015 (2008 not available, 2006 used)
Iceland	ISL	Luxembourg Income Study	Income (to calculate the final 2008 value. However, as no data is available for the years surrounding 1995, the rate of change between 1995 and 2008 needed to be estimated).	The final 2008 value could be calculated with the 2008 LIS data. However, due to the lack of a 1995 estimate anywhere, the rate of change between 1995 and 2008 was estimated.	2007	OECD Stat (1995 is an estimated value by OECD Stat)
India	IND	PovcalNet	Consumption	Same as median	1993, 2009	Trapp 2015
Indonesia	IDN	PovcalNet	Consumption	Same as median	1996, 2008	No data available
Italy	ITA	Luxembourg Income Study	Income	Same as median	1995, 2008	OECD Stat
Ireland	IRL	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
Israel	ISR	Luxembourg Income Study	Income	Same as median	1997, 2007	OECD Stat
Japan	JPN	UNU Wider – WIID 3.3	Income. However, given that the data provided was at the household level without available information on the micro level regarding persons per household, the figure was divided by the 1995 average household size in Japan (NIPPSR 1998) and the 2010 average household size in Japan as a proxy for 2008 (Gu et al. 2015).	The GINI is available to calculate from LIS for 2008 only. For 1995, the "all the Ginis" database provided 4 sources with very close estimates for 1993 and one outlier for 1994. An average of the 1993 estimates was taken.	1995, 2006 for median income data. 1993, 2008 for the GINI calculation.	OECD Stat (1995 is an estimated value by OECD Stat)
Luxembourg	LUX	Luxembourg Income Study	Income	Same as median	1994, 2007	OECD Stat
Malaysia	MYS	PovcalNet	Income	Same as median	1995, 2007	No data available
Mexico	MEX	PovcalNet	Income	LIS data was available for both years, the only country with both years available in both the PovcalNet and LIS databases. LIS data was deemed reliable for the income dispersion to calculate GINIs. But PovcalNet was more reliable for the absolute levels of median income.	1994, 2007 for median income. 1994, 2008 for GINI.	Trapp 2015
Netherlands	NLD	Luxembourg Income Study	Income	Same as median	1993, 2007	OECD Stat

Country	Country code	Median income source	Type of data / complication	GINI Source	Years of reported data	Labor's Share Source
New Zealand	NZL	UNU Wider – WIID 3.3	Income (Not available near the years desired in either LIS or PovcalNet, data comes from OECDStat gathered by the WIID database). Due to its consistency it was used to calculate the rate of change. However, given that it was household reported income and not individual income, the 2008 income level was estimated in order to construct the composite variable of 2008 final value + rate of change between 1995 and 2008	Due to the consistency of the source reporting the GINIs for 1995 and 2008 in the WIID database, coupled with the larger variation around 1995 in the different sources reported in the "all the Ginis" database, the WIID estimates were taken for both 1995 and 2008.	1995, 2008	OECD Stat
Norway	NOR	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
Philippines	PHL	PovcalNet	Consumption	Same as median	1994, 2009	Trapp 2015
Poland	POL	Luxembourg Income Study	Income	Same as median	1995, 2007	Trapp 2015
Portugal	PRT	UNU Wider – WIID 3.3	Income (Not available near the years desired in either LIS or PovcalNet, data comes from the European Commission gathered by the WIID database)	Due to the consistency of the source reporting the GINIs for 1995 and 2008 in the WIID database, coupled with the non-availability of data in the "all the Ginis" database, the WIID estimates were taken for both 1995 and 2008.	1995, 2006	OECD Stat
Romania	ROU	PovcalNet	Consumption	Same as median	1998, 2008	Trapp 2015
Russia	RUS	PovcalNet	Consumption	Same as median	1996, 2008	Trapp 2015
Slovakia	SVK	Luxembourg Income Study	Income	Same as median	1996, 2007	Trapp 2015 (2008 not available, 2006 used)
Slovenia	SVN	Luxembourg Income Study	Income (However, the rate of change was estimated, because there seems to have been a problem with the 1995 data for Slovenia in LIS, thus making a rate of change calculation difficult although the 2008 data is reliable for the final 2008 value).	Luxembourg Income Study (the problem with the 1995 data for Slovenia relates to the absolute magnitude of the 50th percentile value and not to the relative dispersal of income among the whole population, so it was still considered reliable to calculate the GINI.	1997, 2007	OECD Stat
South Africa	ZAF	PovcalNet	Consumption	Same as median	1995, 2008	Trapp 2015
South Korea	KOR	Data not available	Estimated	The GINI is available to calculate from LIS for 2008 only. For 1995, the "all the Ginis" database provides two estimates with the same figure for 1998, one of which also provides a 1993 estimate. The 1993 estimate was therefore taken.	1993, 2006 for GINI.	OECD Stat
Spain	ESP	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
Sweden	SWE	Luxembourg Income Study	Income	Same as median	1995, 2005	OECD Stat
Switzerland	CHE	Report – "L'évolution des inégalités de revenus en Suisse"	Income (Available for 1995 only from the LIS, but not taken since it is available for both years from the same source as an individualized income through the household equivalence scale, the best available data to calculate an internally consistent rate of change)	Luxembourg Income Study is available for 1995 but not for 2008. For 2008, it is listed at 32.3 by two different data sets gathered by the "all the Ginis" database, without any far away values from other data sets, so the 32.3 figure was taken.	1998, 2006 for median income. 1992, 2008 for GINI.	OECD Stat
Thailand	THA	PovcalNet	Consumption	Same as median	1994, 2008	Trapp 2015
Tunisia	TUN	PovcalNet	Consumption	Same as median	1995, 2010	Trapp 2015
Turkey	TUR	PovcalNet	Consumption	Same as median	1994, 2008	Trapp 2015 (2008 not available, 2006 used)
United Kingdom	GBR	Luxembourg Income Study	Income	Same as median	1995, 2007	OECD Stat
United States	USA	Luxembourg Income Study	Income	Same as median	1994, 2007	OECD Stat
Vietnam	VNM	PovcalNet	Consumption	Same as median	1998, 2008	No data available

Gini coefficient

The Gini coefficients, when data was available in the Luxembourg Income Study database, were calculated according to the method provided by the Luxembourg Income Study (2016: 27). The Gini coefficient for "per capita income" was used, in order to be consistent with the way the data from PovcalNet is presented. The Gini scores that were calculated by the distribution income provided by PovcalNet were calculated according to the method developed by Datt (1998) by using the "povcal software" calculator listed in Datt's paper to perform the calculations, taking the Beta Lorenz curve estimates. All Ginis were double checked against all sources with data available for the given years in the "All the Ginis" database. The "All the Ginis" dataset lists all Ginis available from any of eight original sources for all countries for all years from 1950 to 2012. The problem is one of direct comparability between the sources, with no single source providing estimates for the desired years for most countries. The direct calculations from the Luxembourg Income Study and PovcalNet were therefore more desirable for the majority of the countries (see above table). The method of double checking the LIS and PovcalNet calculated Ginis against the "All the Ginis" dataset was to compare the calculated value with all values given within 3 years of the benchmark year from any source reporting in the "All the Ginis" dataset. The direct calculations used from the LIS and PovcalNet data were in all cases within a 20 percent variation range of the majority of available estimates within three years of the benchmark year in the "All the Ginis" database, with the exception of Russia and Romania for 1995, although both of the latter corresponded to the PovcalNet estimate reported in the "All the Ginis" database and thus were kept.

For the eight cases where LIS or PovcalNet data were not available for a GINI calculation for either one year or both (see above table 10), the most consistent number appearing closest to the benchmark years from the "All the Ginis" was taken or, in the cases of New Zealand and Portugal, where there was no consistent figure, the UNU Wider WIID 3.3 database estimate was taken which corresponded to the median income figure and was thus internally consistent. As can be seen in the above table 10, Iceland needed to be estimated for 1995 to calculate the rate of change, since none of the above options provided a reliable figure.

Labor's share of income

The four missing data countries, for both the rate of change and the 2008 values, are Cambodia, Indonesia, Malaysia, and Vietnam. The above table 10 lists the source for all countries, in addition to mentioning if a surrounding year was used rather than the benchmark year in cases of incomplete data, and the three cases where the 1995 value from OECDStat was an estimation on their behalf (all in the labor's share source column). The countries where data could have been taken from either data set are as follows: Czech Republic, Estonia, Hungary, Mexico, Poland, Romania, Slovakia, Turkey. While Trapp's data was taken in all eight of these cases due to the greater attention paid to treating self-employment income in such countries, there was only 1 case out of these 8 where the 1995 values from the different data sets differed by more than 20 percent, and only 2 cases out of 8 where this was the case for the 2008 values.

Other than these issues, there was no need for any additional treatment of the data.

2. Principal component analysis

In this second part of the annex we present some statistical outputs of the principal component analysis that have been excluded from the paper and can interest some readers that would like to enter further into the details. When pertinent to the appraisal of the methodological choices explained in the paper, information regarding the axis that has not been retained (axis F4) has been included.

Table 11: Eigenvalues, variability and cumulative variability for axes F1 to F4

	F1	F2	F3	F4
Eigenvalue	1,225	1,097	1,004	0,674
Variability (%)	30,626	27,427	25,088	16,859
Cumulative %	30,626	58,053	83,141	100,000

Table 12: Eigenvectors for each variable for axes F1 to F4

	F1	F2	F3	F4
PART_INDEX	0,689	0,347	0,203	-0,603
VALCAPT_INDEX	0,023	0,867	-0,150	0,474
INVESTMENT_INDEX	0,705	-0,349	0,037	0,616
SOCIAL_INDEX	-0,168	0,075	0,967	0,177

Table 13: Squared cosines of the variables for axes F1 to F4

	F1	F2	F3	F4
PART_INDEX	**0,581**	0,132	0,041	0,246
VALCAPT_INDEX	0,001	**0,825**	0,023	0,152
INVESTMENT_INDEX	**0,609**	0,134	0,001	0,256
SOCIAL_INDEX	0,035	0,006	**0,938**	0,021

Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Table 14: Factor scores of each observation for axes F1 to F3

Observation	F1	F2	F3
ARG	-0,033	-0,562	-0,428
AUS	-1,148	-2,651	0,300
AUT	-0,416	1,263	0,818
BEL	-0,096	0,020	0,873
BRA	-0,867	0,046	0,006
CAN	-1,045	-0,584	0,355
CHE	-0,046	1,914	1,046
CHL	-0,541	-1,800	-0,306
CHN	2,477	0,573	-0,763

COL	-1,084	-0,096	-1,844
CRI	1,245	0,770	-0,661
CZE	1,342	-0,278	0,025
DEU	-0,437	1,942	0,203
DNK	-0,340	-0,129	0,992
ESP	-0,036	-0,534	0,838
EST	0,603	0,279	-0,093
FIN	0,086	0,255	0,457
FRA	-0,704	0,367	-0,066
GBR	-2,051	1,132	0,360
GRC	-0,901	-1,134	0,179
HRV	1,565	-0,790	-0,871
HUN	0,752	-0,090	0,305
IDN	-0,082	-1,583	-0,388
IND	1,782	-0,302	-1,551
IRL	0,707	0,687	2,251
ISL	-0,247	-1,036	2,856
ISR	-1,295	1,526	-0,925
ITA	-1,009	0,531	-0,183
JPN	-0,061	2,160	-1,243
KHM	-0,150	2,064	0,317
KOR	1,325	-0,189	0,395
LUX	1,648	0,404	1,069
MEX	-0,056	-0,628	-1,726
MYS	1,853	-0,324	-0,131
NLD	-1,539	1,512	0,810
NOR	-1,189	-1,617	0,505
NZL	-1,506	-0,958	0,801
PHL	-1,114	1,257	-1,490
POL	0,797	0,070	-0,964
PRT	-0,940	-0,254	0,271
ROU	0,716	-1,588	-0,374
RUS	-1,233	-1,932	0,088
SVK	1,415	-0,107	0,534
SVN	1,161	0,211	0,385
SWE	-0,292	0,768	0,723
THA	1,605	-0,210	0,334
TUN	0,176	0,270	-0,951
TUR	-1,047	-0,138	-1,571
USA	-1,741	0,193	-0,102
VNM	1,891	-0,209	1,234
ZAF	0,101	-0,491	-2,697

Table 15: Contributions of the observations to axes F1 to F3 (in percentage points)

	F1	F2	F3
ARG	0,002	0,565	0,358
AUS	2,111	12,560	0,176
AUT	0,277	2,853	1,307
BEL	0,015	0,001	1,489
BRA	1,202	0,004	0,000
CAN	1,747	0,609	0,246
CHE	0,003	6,550	2,137
CHL	0,468	5,792	0,183
CHN	9,817	0,587	1,137
COL	1,881	0,016	6,643
CRI	2,482	1,060	0,853
CZE	2,882	0,138	0,001
DEU	0,306	6,744	0,081
DNK	0,185	0,030	1,922
ESP	0,002	0,509	1,371
EST	0,581	0,139	0,017
FIN	0,012	0,116	0,409
FRA	0,793	0,241	0,008
GBR	6,732	2,291	0,253
GRC	1,300	2,300	0,063
HRV	3,918	1,115	1,483
HUN	0,906	0,014	0,182
IDN	0,011	4,479	0,294
IND	5,083	0,162	4,701
IRL	0,800	0,844	9,899
ISL	0,098	1,919	15,939
ISR	2,683	4,162	1,673
ITA	1,630	0,503	0,066
JPN	0,006	8,340	3,020
KHM	0,036	7,611	0,196
KOR	2,810	0,064	0,305
LUX	4,347	0,291	2,232
MEX	0,005	0,706	5,821
MYS	5,497	0,188	0,034
NLD	3,790	4,084	1,281
NOR	2,262	4,674	0,499
NZL	3,630	1,640	1,252
PHL	1,985	2,822	4,339
POL	1,017	0,009	1,814
PRT	1,415	0,116	0,143
ROU	0,821	4,504	0,273
RUS	2,435	6,674	0,015
SVK	3,205	0,021	0,558

SVN	2,157	0,080	0,289
SWE	0,136	1,054	1,022
THA	4,123	0,079	0,217
TUN	0,050	0,130	1,766
TUR	1,754	0,034	4,825
USA	4,852	0,066	0,020
VNM	5,722	0,078	2,973
ZAF	0,016	0,432	14,214

Table 16: Squared cosines of the observations for axes F1 to F4

	F1	F2	F3	F4
ARG	0,001	0,146	0,085	**0,768**
AUS	0,153	**0,816**	0,010	0,021
AUT	0,068	**0,627**	0,263	0,042
BEL	0,012	0,001	**0,986**	0,002
BRA	**0,830**	**0,002**	**0,000**	0,168
CAN	**0,622**	0,194	0,072	0,112
CHE	0,000	**0,728**	0,217	0,055
CHL	0,070	**0,780**	0,022	0,127
CHN	**0,563**	0,030	0,053	0,354
COL	0,255	0,002	**0,737**	0,006
CRI	**0,525**	0,201	0,148	0,127
CZE	**0,906**	0,039	0,000	0,055
DEU	0,045	**0,893**	0,010	0,052
DNK	0,094	0,014	**0,796**	0,096
ESP	0,001	0,147	0,363	**0,488**
EST	**0,497**	0,107	0,012	0,385
FIN	0,015	0,130	0,420	**0,435**
FRA	**0,581**	0,158	0,005	0,256
GBR	**0,748**	0,228	0,023	0,001
GRC	0,370	**0,586**	0,015	0,029
HRV	0,355	0,091	0,110	**0,444**
HUN	0,175	0,002	0,029	**0,794**
IDN	0,002	**0,696**	0,042	0,261
IND	**0,551**	0,016	0,418	0,015
IRL	0,079	0,075	**0,801**	0,045
ISL	0,006	0,112	**0,850**	0,032
ISR	0,345	**0,479**	0,176	0,000
ITA	**0,762**	0,211	0,025	0,002
JPN	0,001	**0,749**	0,248	0,003
KHM	0,005	**0,964**	0,023	0,008

KOR	**0,729**	0,015	0,065	0,191
LUX	0,196	0,012	0,082	**0,710**
MEX	0,001	0,112	**0,844**	0,044
MYS	**0,795**	0,024	0,004	0,176
NLD	**0,358**	0,346	0,099	0,197
NOR	0,328	**0,607**	0,059	0,006
NZL	**0,591**	0,239	0,167	0,003
PHL	0,238	0,303	**0,426**	0,033
POL	0,283	0,002	**0,413**	0,302
PRT	**0,831**	0,061	0,069	0,040
ROU	0,151	**0,740**	0,041	0,068
RUS	0,267	**0,655**	0,001	0,077
SVK	**0,541**	0,003	0,077	0,379
SVN	**0,677**	0,022	0,074	0,226
SWE	0,066	**0,456**	0,405	0,073
THA	**0,942**	0,016	0,041	0,001
TUN	0,029	0,067	**0,832**	0,073
TUR	0,285	0,005	**0,642**	0,068
USA	**0,979**	0,012	0,003	0,005
VNM	**0,661**	0,008	0,281	0,049
ZAF	0,001	0,029	**0,867**	0,103

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

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